Remarks

The Applicant has cancelled Claims 1, 2, 4, 6, 7, 9 and 10, and has added new Claims 15–21. Therefore Claims 11–21 are currently pending in this application. Claims 11, 15 and 19 are independent.

Claim Rejections Under 35 U.S.C. § 103(a) (Claims 1, 2, 4 and 10–13).

The Examiner has rejected Claims 1, 2, 4 and 10–13 as being obvious based on U.S. Patent 3,867,156 ("Fukumoto '156") in view of U.S. Patent 2,883,347 ("Fisher") and U.S. Patent 3,717,486 ("Fukumoto '486"). Claims 1, 2, 4 and 10 have been cancelled, and thus the Applicant respectfully requests that the rejection of these claims be withdrawn. Independent Claim 11 has been amended; Claims 12 and 13 depend therefrom.

Fukumoto '156 discloses a process for manufacturing foamed products of silica by subjecting a silica gel to a heat-treatment (see Fukumoto '156 at 1:1:66–2:9). The heat-treatment includes an optional pre-firing stage that is conducted at 500 °C to 900 °C for between 30 minutes and 90 minutes (see Fukumoto '156 at 3:65–4:1, Example 1 and Comparison Example 2). The heat-treatment also includes firing at 1000 °C to 1600 °C for 3 to 10 minutes, although it is also disclosed that longer firing times can be applied without any adverse effect (see Fukumoto '156 at 3:64–65 and 4:48–50).

Fukumoto '486 also discloses a process for manufacturing foamed products of silica by subjecting a silica gel to a heat-treatment that includes both pre-firing and firing stages (see Fukumoto '486 at 1:44–52). It is disclosed that the time required for elevating the temperature from the pre-firing temperature to the firing temperature influences the surface strength of the finished product, and that it is preferable that the temperature be elevated within 20 minutes (see Fukumoto '486 at 3:68–4:10).

Fisher discloses methods for forming expanded silica spheres by granulating a mixture of fused quartz, silica gel and a aqueous colloidal silica binder (see Fisher at 4:58–59 and 4:69–71). This mixture is then fired to agglomerate the colloidal silica and activate it as a binder, and remove excess water (see Fisher at 5:25–32). Fisher

discloses that "the desired firing temperature should be approached slowly" to aid the burning out of entrapped organic hydrolysis products (see Fisher at 6:10–12).

First, the cited references do not disclose "performing a heat-treatment on a plurality of silica gel pellets for *n* minutes, wherein the heat-treatment includes a temperature increasing stage of duration about *n*/2 minutes, and a temperature maintaining stage of duration about *n*/2 minutes", and the Examiner has not pointed to any reason why an ordinarily-skilled artisan would perform such a heat-treatment based on the teachings in the cited references.

The Examiner has not pointed to any teaching in the cited references of the particular relationship recited in Claim 11 between the heat-treatment duration (*n*), the temperature increasing stage duration (*n*/2) and the temperature maintaining stage duration (*n*/2).

Acknowledging this shortcoming, the Examiner first asserts that Fukumoto '156 discloses that heat-treatment times "may be selected to achieve a desired foaming and firing effect". However, the passage that the Examiner cites to support this assertion, Fukumoto '156 at 4:25–50, actually discloses something quite different. What is actually disclosed is that firing usually completes within three to ten minutes, and that longer firing times can be applied without any adverse effect. Thus, contrary to the Examiner's assertion otherwise, this is a clear statement that adjusting the firing time actually **does not** produce any particular desired foaming and firing effect.

A particular parameter must first be recognized as a "result-effective variable"—that is, a variable which achieves a recognized result—before the determination of the optimum ranges of said variable might be characterized as routine experimentation (see MPEP 2144.05(II)(B)). The statement in Fukumoto '156 that longer firing times can be applied without any adverse effect is actually a recognition that the firing time is **not** a result-effective variable: increasing the duration is said to have **no** adverse effect. The Examiner has therefore not provided any reason that an ordinarily-skilled artisan would optimize the firing times disclosed in Fukumoto '156.

The Examiner also asserts that the Fisher suggestion to approach the desired firing temperature slowly, when taken with the Fukumoto '486 suggestion to elevate to

the firing temperature within 20 minutes, would lead an ordinarily-skilled artisan to optimize the duration of the temperature increasing stage. Even assuming only for the sake of argument that the Examiner's assertion in this regard is accurate, this still would not lead the ordinarily-skilled artisan to correlate the heat-treatment duration (*n*), the temperature increasing stage duration (*n*/2) and the temperature maintaining stage duration (*n*/2) according to the particular relationship recited in Claim 11. Significantly, Claim 11 does not recite particular parameter ranges that might be optimized, but rather recites a particular **relationship** between specified parameters which cannot be found in the cited references.

Second, none of the cited references disclose that "during the temperature increasing stage the silica gel pellets are heated from ambient temperature at between about 5°C min^{-1} and about 70°C min^{-1}" (emphasis added), and there is no reason why an ordinarily-skilled artisan would heat the silica gel pellets in this way.

As noted previously, Fukumoto '156 discloses a heat-treatment wherein either (a) a silica gel is directly fired at 1000 °C to 1600 °C, or (b) a silica gel is optionally pre-fired at 500 °C to 900 °C before firing at 1000 °C to 1600 °C (see Fukumoto '156 at 3:64–4:1). In either case, the silica gel is never "heated from ambient temperature at between about 5°C min^{-1} and about 70°C min^{-1}". Likewise, Fukumoto '486 discloses a heat-treatment similar to that of Fukumoto '156, except that the pre-firing disclosed in Fukumoto '486 is characterized as being "required" (see Fukumoto '486 at 3:44–45). Again, this means that the silica gel is never "heated from ambient temperature" at the specified temperature gradient. Thus, Fukumoto '486 cannot remedy the shortcomings of Fukumoto '156.

Nor can Fisher remedy these shortcomings. Similar to Fukumoto '156, Fisher also discloses directly firing at about 1000 °C (see Fisher at 5:16–23). However, as noted previously, the Fisher firing stage is applied to a mixture of fused quartz, silica gel and an aqueous colloidal silica binder (see Fisher at 4:58–59 and 4:69–71). These are different materials than the materials being fired in either of the Fukumoto references, and they are also different from the materials recited in Claim 11. Furthermore, in

Fisher, the firing stage is conducted to agglomerate the colloidal silica and activate it as a binder, as well as to remove excess water (see Fisher at 5:25–32). Fisher discloses that "the desired firing temperature should be approached slowly" to aid the burning out of entrapped organic hydrolysis products (see Fisher at 6:10–12). Neither of the Fukumoto references disclose any concern for controllably burning out organic hydrolysis products which are undergoing heat-treatment. Thus the firing stage disclosed in Fisher is applied to different materials, in different contexts and for different purposes compared to the firing stages disclosed in the Fukumoto references. Therefore, an ordinarily-skilled artisan would not look to Fisher for guidance on how to improve or otherwise modify the teachings of Fukumoto '156 and/or Fukumoto '486.

Finally, the Examiner has not pointed to any teaching in the cited references of a temperature-increasing stage being performed in a rotary tube furnace.

Claim 11 recites, among other things, that the heat-treatment, which includes a temperature increasing stage, "is performed in a rotary tube furnace". The Examiner has asserted that Fukumoto '156 discloses this feature, citing 7:17–19 (Example 1) and 8:35–36 (Example 3). It should be noted that while these portions of Fukumoto '156 disclose that the **firing** stage is performed in a rotary kiln, they do not indicate what type of furnace is used during the pre-firing stage which, significantly, can be several times longer than the firing stage. Indeed, in the context of Comparison Example 2, it is specifically disclosed that the pre-firing stage is conducted in a tunnel kiln.

In conclusion, the Examiner has not established a *prima facie* case of obviousness of Claim 11 based on the combined teachings of Fukumoto '156, Fukumoto '486 and Fisher. First, the cited references do not disclose "performing a heat-treatment on a plurality of silica gel pellets for *n* minutes, wherein the heat-treatment includes a temperature increasing stage of duration about *n*/2 minutes, and a temperature maintaining stage of duration about *n*/2 minutes", and the Examiner has not pointed to any reason why an ordinarily-skilled artisan would perform such a heat-treatment based on the teachings in the cited references. Second, none of the cited references disclose that "during the temperature increasing stage the silica gel pellets

are heated **from ambient temperature** at between about 5°C min^{-1} and about 70°C min^{-1}" (emphasis added), and there is no reason why an ordinarily-skilled artisan would heat the silica gel pellets in this way. Finally, the Examiner has not pointed to any teaching in the cited references of a temperature-increasing stage being performed in a rotary tube furnace.

Based on the foregoing, the Applicant therefore respectfully submits that independent Claim 11 is allowable over the combined teachings of Fukumoto '156, Fukumoto '486 and Fisher, and respectfully requests that this rejection be withdrawn. Because Claims 12 and 13 depend from independent Claim 11, and more specifically define the claimed invention, the Applicant respectfully submits that Claims 12 and 13 are allowable over the combined teachings of Fukumoto '156, Fukumoto '486 and Fisher for at least the same reasons that independent Claim 11 is allowable, and respectfully requests that these rejections be withdrawn as well.

Claim Rejections Under 35 U.S.C. § 103(a) (Claims 6, 7, 9 and 14).

The Examiner has rejected Claims 6, 7, 9 and 14 as being obvious based on Fukumoto '156 in view of Fisher and U.S. Patent 4,392,988 ("Dobson"). Claims 6, 7 and 9 have been cancelled, and thus the Applicant respectfully requests that the rejection of these claims be withdrawn. Claim 14 has been amended to depend from new independent Claim 19, and is allowable over Fukumoto '156, Fisher and Dobson for the same reasons expounded below with respect to Claim 19. The Applicant therefore respectfully requests that the rejection of dependent Claim 19 be withdrawn as well.

New Claims 15–21.

Claims 15–18. The Applicant has added new Claims 15–18. Claim 15 is independent and Claims 16–18 depend therefrom.

New independent Claim 15 recites a method for fabricating a porous silica sphere that comprises a combination of features, including, among other things, "placing a plurality of silica gel pellets in a rotary tube furnace" and "upon placing the

silica gel pellets in the rotary tube furnace, increasing the temperature in the rotary tube furnace at between about 5 °C min^{-1} and about 90 °C min^{-1}, until the temperature is between about 1050 °C and about 1200 °C". The Applicant respectfully submits that the art of record does not teach this feature.

For example, the methods disclosed in Fukumoto '156 require forming the silica gel by adding a water-insoluble inorganic powder to a silica sol, which is subsequently gelled and dried (see Fukumoto '156 at 1:66–2:9). Indeed, this step is characterized as being "critical" (see Fukumoto '156 at 2:36–38). Forming the silica gel in this fashion results in a gel that comprises sharp, fractured particles having an irregular shape, as contrasted with the "pellets" recited in Claim 15.

To verify this distinction, the Applicant conducted an experiment wherein two silica gels were prepared using the technique described in Fukumoto '156 and two silica gels were prepared using commercially-available gels in pellet form. The details of these experiments are provided in the attached Declaration Under 37 C.F.R. § 1.132 ("the 2011 Kim Declaration"). $A\ell_2O_3$ was used as the water-insoluble inorganic powder for the preparation of the Fukumoto '156 gels. In each case, one of the gels was sized at +20 mesh, while the other gel was –20 mesh. The gels were separately heat-treated at 1000 °C for 3 minutes, and then photographed. These photographs, which are provided in Exhibit A of the 2011 Kim Declaration, illustrate that the silica gel particles prepared using the $A\ell_2O_3$ powder are sharp, fractured particles having an irregular shape. This shows that the Fukumoto '156 methods which require forming the silica gel by adding a water-insoluble inorganic powder to a silica sol are not relevant to recitation in Claim 15 of "a plurality of silica gel pellets".

Just as the methods disclosed in Fukumoto '156 do not produce "a plurality of silica gel pellets", the methods disclosed in Fisher must fail in this regard as well. As expounded above with respect to Claim 11, Fisher discloses methods for forming expanded silica spheres by granulating a mixture of fused quartz, silica gel and a aqueous colloidal silica binder (see Fisher at 4:58–59 and 4:69–71). This mixture is then fired to agglomerate the colloidal silica and activate it as a binder, and remove

excess water (see Fisher at 5:25–32). Fisher's disclosure of a step that agglomerates the gel is not relevant to the recitation in Claim 15 of "a plurality of silica gel pellets".

Finally, it is noted that even though Fukumoto '486 discloses use of a commercially available silica gel as a starting material (see Fukumoto '486 at 3:3–5), this reference is also not relevant to the combination of features recited in Claim 15. Specifically, Claim 15 recites that upon placing the silica gel pellets in the rotary tube furnace, the temperature in the rotary tube furnace is increased at between about 5 °C min^{-1} and about 90 °C min^{-1}, until the temperature is between about 1050 °C and about 1200 °C. This is incompatible with the Fukumoto '486 disclosure of a "required" pre-fire conducted at 500 °C to 900 °C, after which the gel is heated to 1000 °C to 1450 °C for firing to effect foaming (see Fukumoto '486 at 3:44–46 and 3:67–68). Because of the structural differences between the starting materials used in the two Fukumoto references, an ordinarily-skilled artisan would not expect that the methods disclosed in those references would be interchangeable with each other. See Paragraph 9 of the 2011 Kim Declaration.

Thus, based on the foregoing, the Applicant respectfully submits that new Claim 15 is allowable over the art of record. Furthermore, because new dependent Claims 16–18 depend from independent Claim 15, and more specifically define the claimed invention, the Applicant respectfully submits that Claims 16–18 are allowable over the art of record for at least the same reasons that independent Claim 15 is allowable.

Claims 19–21. The Applicant has also added new Claims 19–21. Claim 19 is independent and Claims 20 and 21 depend therefrom.

New independent Claim 19 recites a method for fabricating a porous silica sphere that comprises a combination of features, including, among other things, "placing a plurality of silica gel pellets in a first rotary tube furnace". The Applicant respectfully submits that the art of record does not teach this feature.

As expounded above with respect to Claim 15, the methods disclosed in Fukumoto '156 require forming the silica gel by adding a water-insoluble inorganic powder to a silica sol, which is subsequently gelled and dried (see Fukumoto '156 at 1:66–2:9). This step is characterized as being "critical" (see Fukumoto '156 at 2:36–38).

Forming the silica gel in this fashion results in a gel that comprises sharp, fractured particles having an irregular shape, as contrasted with the "pellets" recited in Claim 19. An ordinarily-skilled artisan would not expect that the methods disclosed in Fukumoto '156 would be applicable to methods applied to the "pellets" recited in Claim 19. See Paragraph 9 of the Kim Declaration.

Just as the methods disclosed in Fukumoto '156 do not produce "a plurality of silica gel pellets", the methods disclosed in Fisher must fail in this regard as well. As expounded above with respect to Claim 11, Fisher discloses methods for forming expanded silica spheres by granulating a mixture of fused quartz, silica gel and a aqueous colloidal silica binder (see Fisher at 4:58–59 and 4:69–71). This mixture is then fired to agglomerate the colloidal silica and activate it as a binder, and remove excess water (see Fisher at 5:25–32). Fisher's disclosure of a step that agglomerates the gel is not relevant to the recitation in Claim 19 of "a plurality of silica gel pellets".

Furthermore, while Fukumoto '156 discloses that the **firing** stage is performed in a rotary kiln, it does not specifically indicate what type of furnace is used during the pre-firing stage which, significantly, can be several times longer than the firing stage. Indeed, in the context of Comparison Example 2, it is specifically disclosed that the pre-firing stage is conducted in a tunnel kiln.

Thus, based on the foregoing, the Applicant respectfully submits that new Claim 19 is allowable over the art of record. Furthermore, because new dependent Claims 20 and 21 depend from independent Claim 19, and more specifically define the claimed invention, the Applicant respectfully submits that Claims 20 and 21 are allowable over the art of record for at least the same reasons that independent Claim 19 is allowable.

For example, new dependent Claim 20 recites, among other things, "holding the silica gel pellets in the second rotary tube furnace for between about 20 minutes and about 60 minutes while the temperature remains between about 1050 °C and about 1200 °C". The Examiner has previously acknowledged that Fukumoto '156 does not disclose this feature, but has instead taken the position that Fukumoto '156 discloses that heat-treatment times "may be selected to achieve a desired foaming and firing effect". However, as expounded previously with respect to Claim 11, Fukumoto '156

actually discloses that firing usually completes within three to ten minutes, and that longer firing times can be applied without any adverse effect. Thus, contrary to the Examiner's assertion otherwise, this is a clear statement that adjusting the firing time actually **does not** produce any particular desired foaming and firing effect.

A particular parameter must first be recognized as a "result-effective variable"—that is, a variable which achieves a recognized result—before the determination of the optimum ranges of said variable might be characterized as routine experimentation (see MPEP 2144.05(II)(B)). The statement in Fukumoto '156 that longer firing times can be applied without any adverse effect is actually a recognition that the firing time is **not** a result-effective variable: increasing the duration is said to have **no** adverse effect. The Examiner has therefore not provided any reason that an ordinarily-skilled artisan would optimize the firing times disclosed in Fukumoto '156.

No Disclaimers or Disavowals

Although this communication may include amendments to the application, and may characterize the claim scope and/or referenced art, the Applicant does not concede that previously pending claims are not patentable over the cited references. Rather, any amendments and/or characterizations are being made to facilitate expeditious prosecution of this application. The Applicant reserves the right to later pursue any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history cannot reasonably infer that the Applicant has made any disclaimers or disavowals of any subject matter supported by the present disclosure.

Conclusion

In view of the foregoing, this application is believed to be in condition for allowance, and such allowance is respectfully requested. Should the Examiner believe that a telephone conference or personal interview would facilitate resolution of any

remaining matters, the Examiner may contact the Applicant's attorney at the number given below.

The Commissioner is authorized (a) to charge LEXYOUME's Deposit Account No. 504054 for any fees required under 37 C.F.R. §§ 1.16 and 1.17 that are not covered, in whole or in part, by a credit card payment form submitted herewith, and (b) to credit any overpayment to said Deposit Account No. 504054.

Respectfully submitted,

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